in Illinois, the wreckage was not widespread. In fact, it seems that over this portion of the path the tornado's tube was not continuously in contact with the ground, but the winds, which were not markedly of a whirling nature, were excessively high. An interesting phase of the storm was the finding of papers in Hillsboro, Litchfield, and Mount Olive, Ill., that belonged to people in the devastated area of St. Louis. These towns are 40 to 50 miles northeast of a point just north of the McKinley Bridge across the Mississippi, where the storm crossed the river. The papers seemed to have dropped from the sky.

The time taken in the passage of the storm from southwestern St. Louis to the southeast of Granite City, in Illinois, is not known. All reports of first damage in St. Louis place the time "about 1 p. m." An instantaneous drop and rise in the barometer trace in the Weather Bureau office (1¾ miles southeast of the nearest edge of the storm, and 3 miles from the center) took place at 1.02 p. m., and the extreme wind velocity (96 miles an hour) was at the same time. Reports from the Illinois side of the river place the time of the storm "a few minutes after 1 p. m."

Where the storm crossed streets lined with trees it was quite easy to trace the center of the path by the direction in which the trees were lying. Some of the trees were twisted as much as 90° before being leveled. One plainly marked feature of the storm, and an interesting one, is the fact that the damage on the left, or west side of the storm's center, as indicated by the reversed direction in which trees were laid down, was confined to a very narrow strip, while on the right, or east side there was a broad swath of damage and destruction. In fact, there were many places in which the damage did not extend more than one or two hundred feet to the west of the first tree lying in a generally easterly direction.

A comparative analysis of the storm would be impossible, but judging from the reports of the character of destruction and from the pressure falls recorded by the nearest barographs, this tornado was not as violent in a meteorological sense as the St. Louis tornado of May 27, 1896, and the southern Illinois tornado of March 18, 1925. The instantaneous fall in pressure at St. Louis University, three-fourths of a mile southeast of the center of the path of the storm, was 0.20 inch. The fall was followed by an immediate rise to the former reading. At the Weather Bureau office, also southeast of the path, but 3 miles from the storm's center, the instantaneous fall was only 0.11 inch; however, the rise, which immediately followed, was 0.22 inch. In the Little Rock, Ark., tornado of October 2, 1894, the pressure fall was 0.37 inch and the following rise was to the original reading. The barograph in St. Louis on May 27, 1896, acted very much as it did on September 29, 1927; that is, it indicated a pressure fall of 0.22 inch, and the following rise was greater, being 0.40 inch. (The barograph was about three-fourths of a mile from the center of the storm.) On March 18, 1925, a tornado occurred in southern Illinois; it was one of the severest tornadoes of record. A barograph trace said to have been made less than a mile from the outer edge of the storm showed an instantaneous fall, and a following rise, of 0.20 inch.

Destruction of life and property is obviously no criterion of the relative severity of storms. The path of the recent storm was through a section of the city consisting mainly, but not altogether, of rather old residences, flat buildings, and stores. The construction of these buildings can not be said to have been generally poor, although it was decidedly poor in some instances. However, the construction, as a rule, was by no means what it should have been, and the fact that at least two modern apartment buildings were damaged no more than was to be expected seems to bear out this assertion. There is considerable discussion and criticism of the mortar used in the damaged and razed buildings. Other phases of construction are also being discussed and criticized to to some extent, and the entire matter may result in changes in building practices. The apartment buildings mentioned had windows blown out and some parapet walls blown off. In most of the damaged buildings near the storm's center the explosive effect was plainly marked.

In St. Louis 72 people were killed; of this number several died of injuries some days or weeks after the storm. The injured numbered around 500. Fortunately there were few fires following the storm. In Illinois seven people were killed and one man died of heart failure; there were about 50 injured.

The monetary damage is, of course, not definitely known, and probably never will be. A careful survey in St. Louis indicates that, exclusive of motor cars and the contents of buildings of whatever nature, the damage amounted to $22,000,000. In Illinois the total damage probably was less than $3,000,000.

NOTE.—The following legends, as well as the photographs here reproduced, were made and furnished by H. J. Woods, engineer of the Missouri Inspection Bureau:

FIG. 1.—Typical destruction of residence 4017 Enright Avenue

FIG. 2.—Columbia School (public), 2742 North Garrison Avenue. Walls blown out, particularly at southwest and southeast corners; roof practically destroyed. In some instances the brickwork between the windows only the face brick remained

FIG. 3.—Bucks Stove & Range Co., east side Second Street, between Destrehan and Mallinckrodt Streets. Heavy damage occurred on upper floors of the four and five story buildings. Buildings suffered in breakage of windows and one from falling stacks

FIG. 4.—Polar Wave Ice & Fuel Co., 4428 Duncan Avenue. Ice-storage house, having 4-inch dead air space in walls, vented at top and bottom of wall, as shown in photograph. Four-inch brick outer wall forced out by air pressure during storm. Greater destruction to other parts of plant; several men killed

FIG. 5.—Three residences completely destroyed—4106, 4112, and 4114 Enright Avenue

FIG. 6.—Examples of recent construction of small apartments using hollow tile with brick facing. Doubtless conditions could have been greatly improved by proper bonding of these walls and by the use of cement mortar

FIG. 7.—Showing destruction of facing over flues due to sudden drop in barometric pressure during tornado

FIG. 8.—Looking north from alley between Olive Street and Washington Boulevard. View of the rear of residences in the 4100 block on Washington Boulevard

FIG. 9.—View of the north side of 4100 block of Washington Boulevard. NOTE.—One structure shows second floor completely wiped out and third floor of mansard construction occupying former position of second floor, front room

FIGS. 10, 11.—Leonardo Fireproof Apartments, 4166 Lindell Boulevard. Part of west side shown in above photograph; entire window, including casing, on first floor, pushed out; damage to windows above. Rear view shows damage to parapet and to windows

FIG. 12.—Four O Six Six Fireproof Apartments, 4066 Lindell Boulevard. This apartment nearing completion; windows not all installed

METEOROLOGICAL CONDITIONS OVER THE SEA IN THE EASTERN MEDITERRANEAN

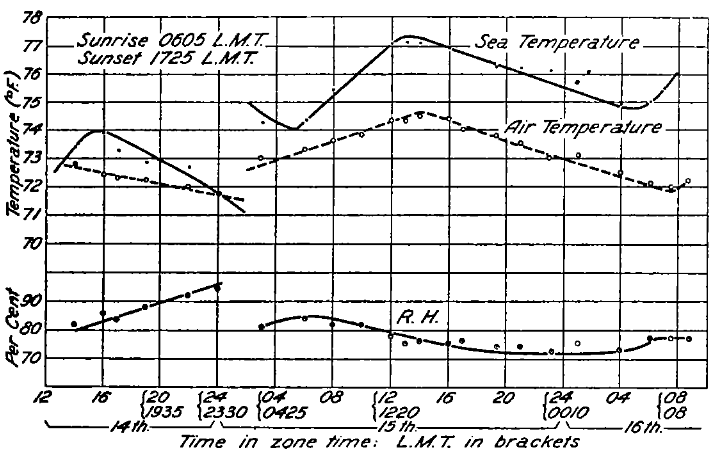
By H. MEREDITH, B. Sc.

The observations referred to in the following article were made on October 14, 15, and 16, 1926, during a voyage in the Mediterranean Sea between Alexandria and Malta, and consist of measurements of the sea-surface temperature, the air temperature, and relative humidity at 21 feet above the water level, together with the air-temperature gradient between the heights of 13 feet and 71 feet above the sea level. The observations were taken approximately at two-hour intervals throughout the voyage. Alexandria was left at about 1400 on October 13 and Malta was reached at 1000 October 16, the ship steaming a steady 12 knots throughout. The weather conditions remained sensibly the same during the period covered by the observations, the condition of the sea being slight to calm, with no swell.

The sea temperatures were taken by the bucket method, using a canvas bucket of the nature and dimensions described by Doctor Brooks,[1] the sample being taken from as near the surface of the sea as possible, the cast being made from well forward on the bow of the ship.

The actual temperature of the water sample was taken by means of a thermometer, previously calibrated against the air-temperature thermometer, a quick stir and rapid reading being the standard practice for each sample, while samples were continuously taken until two consecutive readings were the same. It was found that only on rare occasions were more than two samples required, indicating that drawing up water by this method from a moving vessel insures complete mixing within the sample, and errors through cooling would ensue were the thermometer allowed to remain for three minutes as recommended in the Meteorological Handbook for Observers.

In this connection tests were made of samples from three positions, namely, that of the standard position mentioned above, another from the weather side of the bow, and a third from the lee side of the bow, the latter two positions being 15 yards aft of the former one. On only one occasion was there any difference in the readings, this exception being a very slight increase in the case of a single sample taken from the lee side (the sunny side, incidentally) about midday.



Further, provided the thermometer was kept well centered in the water in the bucket, there was no decrease in temperature during the period required (approximately 30 seconds) to take three readings. When the thermometer was allowed to touch the inside of the canvas there was naturally a sharp drop of from 0.5° to 1° F. in the reading.

On completion of the readings the bucket sample was allowed to remain filled with water. During the period intervening between observations the water would gradually ooze away and the upper portion of the bucket become dry and warm. Thus, heat lost by cooling of the wet portion of the canvas was partially counterbalanced by the heating by the sun of the dry portion. It was found that if the sample was emptied from the bucket each time, as recommended by Professor Merx,[2] the wooden bottom of the bucket became dry and hot and the next reading would be inaccurate through this cause. To guard still further against errors due to the bucket being heated, it was allowed to remain in the water before bringing up a sample for such time as it took to take the readings of the air temperature and temperature gradient. Previous to pulling inboard a sample of water one or two bucketfuls would be hauled clear of the water and, by means of a sharp twist of the rope, emptied of its contents, and the bucket plunged into the water once more for the best sample.

It will thus be seen that the final sample would be expected to bear a very close approximation to the conditions actually obtaining in the upper 6 inches of the sea.

The results of the observations are plotted in the accompanying graph. Zone time is plotted along the base and, bracketed with some of the hour periods, is the corresponding local mean time. The change for "G. M. T. plus 2 hours" to "G. M. T. plus 1 hour" was made in two half-hours at midnight October 14–15.

It will be seen from the graph that a definite break occurs at midnight October 14–15, corresponding to the ship's position off Cyrenaica and is accounted for by the fact that, with certain winds from the north, a northeasterly current of 16 to 20 nautical miles per day is set up, which brings down colder water from the Dardanelles. This stream, on meeting the African coast, is turned eastward along the North African coast, where its cooling effect is soon lost.[3]

During the voyage the wind blew consistently from a northerly direction, and undoubtedly the cooler Dardanelles current is here portrayed, its effect being lost shortly after midnight. As a confirmatory circumstance, light fog was encountered at midnight 20 miles off Cape Ras el Tin (Cyrenaica), while the moon was seen to sink behind a dense bank of fog to landward.

On the 15th there is a rise in temperature during the day of approximately 3° F. and a fall during the night of the 15th–16th of nearly 2.5° F. Such a diurnal variation is not usually encountered in more open waters such as the Atlantic Ocean. The upward and downward slopes of the graph show a very pronounced regularity, and there are indications that the rise in temperature in the forenoon takes place at a far greater rate than the decrease afterwards, the former averaging 0.3° F. and the latter less than 0.2° F. per hour.

The maximum temperature is reached on the first day between 1340 and 1540 local mean time, and on the second day between 1220 and 1420 local mean time, giving 1400 hours as a possible maximum period.

The minimum values for both the 14th–15th and the 15th–16th are indefinite, but indicate with same assurance that the effect of sunrise on the temperature of the water is immediate and appreciable.

Whereas the maximum temperature of the uppermost layer of the soil has been found, by extrapolation of maxima at varying depths, to occur at midday, it is here found that over the sea the maximum of the upper sea surface, as measured by the bucket-sample method, occurs at least one hour later. This lag is undoubtedly due to the turbulence in the upper layers of the sea, which rapidly conveys downward the heat accumulated at the water surface. This lag, then, is a function of the sea disturbance and will tend to increase up to a certain limit, with increase in the sea disturbance, although the latter itself would have a limit beyond which it would tend to decrease this lag in the maximum temperature.

As regards the air temperatures and the relative humidities. An Assmann thermometer was used for taking the temperatures, the wet-bulb thermometer being first

[1] Mo. Wea. Rev., June 1926, 54 : 241–253.
[2] Die Oberflächentemperature der Gewässer.
[3] Monthly Meteorological Chart of the Mediterranean Basin, October.

calibrated against the dry-bulb thermometer. Readings were taken from well forward in the "eyes" of the ship, the Assmann being held on the weather side and readings taken every half minute until two consecutive readings were identical.

The points as plotted in the accompanying graph indicate temperatures less than that of the sea surface and having a diurnal range of similar magnitude to that of the sea temperature, namely 3° F. The premaximum rate of increase appears to be less than that of the sea temperatures, while the slope of the line indicating its rate of decrease in temperature after the maximum is almost parallel to that of the sea temperature for a corresponding period.

As indicated by the values for the 15th–16th, the maximum air temperature is reached about one hour after the corresponding point for the sea temperature, while a similar interval occurs between the hours of minimum temperature. This is to be expected by reason of the temperature superiority displayed throughout by the sea surface and corresponds to what occurs over the land But since the temperature superiority of sea water over the air above it is less than for corresponding day times in the case of land, the lag of the air temperature would be expected to be of a lower order.

The fog off Ras el Tin on the night of the 14th–15th is clearly manifested by the record of the relative humidities. Apart from this phenomenon, the record indicated a distinct diurnal variation in the relative humidity of the air, with a maximum at sunrise on the 15th and a minimum in the afternoon of the same day.

As regards the temperature gradient between 13 feet and 71 feet above sea level. The apparatus used was identical with that described by N. K. Johnson in his article in the Quarterly Journal.[4]

In brief the apparatus consisted of a pair of platinum resistance thermometer elements, placed one over the bow of the ship, 13 feet above the water, and the other at the masthead at a height of 71 feet. Both elements were protected from incoming solar radiation and were aspirated at a constant rate by means of two fans and lengths of tubing. By adapting a Wheatstone bridge circuit, the *difference* between the resistance of the two elements could be ascertained, and hence the difference in temperature at the two heights. Although originally designed to measure only to the nearest 0.1° C., it was found that the instrument was surprisingly accurate to 0.01° C.

Although not clearly portrayed, there are indications in the results obtained during the voyage of the following:

(*a*) A decrease in the lapse rate as midnight, 14th–15th, is approached. This might be expected from the fact that at midnight fog conditions abounded and the temperature of the sea and that of the air at 20 feet were equal.

(*b*) There are indications of a decrease in the lapse rate at sunrise on the 15th, a steady lapse rate thence to midday, when the lapse rate gradually increased until sunset.

[4] Quarterly Journal Meteorological Society, vol. 53, No. 221.

Meteorological data for October 14, 15, and 16

Time	1400	1600	1700	1900	2200	Midnight	0300	0600	0800	1000	1200	1300	1400	1600	1700	1920	2100	2300	0100	0400	0600	0730	0845
Sea temperature	73.4	73.9	73.3	72.9	72.7	71.8	74.3	74.4	75.5	75.5	77.1	77.1	77.1	76.9	76.3	76.3	76.2	76.1	75.8	75.0	75.1	75.5	75.4
Air temperature	72.8	72.4	72.3	72.2	72.0	71.7	73.0	73.3	73.6	73.8	74.3	74.3	74.5	74.4	74.0	73.8	73.5	73.0	73.1	72.5	72.1	72.0	72.2
Temperature gradient	−.20	------	−.23	−.22	−.21	------	−.24	−.21	−.22	−.21	------	------	−.24	------	−.26	------	------	------	−.23	−.21	------	------	------
Wind (m./sec.)	3	------	3	4	4	8	6	7	------	------	------	------	4	3	------	3	------	0–1	------	3	2	------	4
Relative humidity	82	86	84	88	92	94	81	84	82	82	78	75	76	75	76	74	74	72	75	73	77	77	77

Sea and air temperatures are in degrees Fahrenheit. Temperature gradient is measured in degrees centigrade, negative values indicating a lapse rate between 13 and 71 feet above water level. Times are in zone times. (See text.)

ICE FORECASTING BY MEANS OF THE WEATHER

[Reprinted from U. S. Coast Guard Bulletin No. 15, "International ice observations and ice patrol service in the North Atlantic"]

One of the most important scientific problems that has confronted the ice patrol for some time is the desire to obtain advance information regarding the annual amount of ice to be expected south of Newfoundland. If the master of the *Titanic* had known, as we can clearly see to-day, that the year 1912 was one in which icebergs by the hundreds invaded the North Atlantic to low latitudes, he would probably have navigated his command farther south, and more cautiously, past the Arctic ice barrier. The amount of ice drifting out of the north into the open Atlantic is subject to great annual variations; for instance, in 1912 there were approximately 1,200 bergs counted south of Newfoundland while in 1924 there were only a total of 11. Several investigations have been made of the relation between the amounts of ice in the northeastern North Atlantic and logical contributary factors, but only a few similar papers have dealt with the ice stream past Newfoundland.

All of the investigators, Schott, Mecking, Brenneck, Weisse, and Meinardus found that the wind was the most important factor which governs the southward drift of polar ice. The ice patrol, with the assistance of the British Meteorological Office and more recently the United States Weather Bureau, has begun an investigation into the effect of the weather upon the distribution of icebergs. It is desired, therefore, under this section devoted to weather to give a brief account of the results so far of this research work. The period embraces 47 years, 1880–1926, a series of sufficient length to permit mathematical correlation, and in this respect it has an advantage over previous works.

The results differ somewhat from those previously obtained by Mecking in that the chief importance is assigned to the variations of the pressure difference between Belle Isle, in Newfoundland, and Ivigtut, in southern Greenland, during the period December to March. The pressure difference directly affects the amount of field ice, and it has been found that there is a very close relation between the amount of field ice and the number of bergs south of Newfoundland. The field ice tends to act as a fender along the shoreward side of the Labrador current, and thus more or less prevents the bergs from stranding as they are borne southward. The truth of this statement was curiously revealed during the 1924 patrol, when the unusual absence of field ice left the season's crop of bergs to strand in northern waters. When the sea ice recedes northward, due to melting in May, the coast line becomes more and more exposed. Stranding takes place on a great scale, and the consequent supply of bergs to the Grand Banks is cut off. The iceberg